CONVENTIONAL FACILITIES

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The NIF Conventional Facilities include the Laser and Target Area Building (LTAB) and the Optics Assembly Building (OAB). The LTAB will be an environmentally controlled facility for housing the laser and target area systems. It has two laser bays, two optical switchyards, a target room, target diagnostic facilities, capacitor areas, control rooms, and a few operations support areas. The OAB includes a loading dock for receiving and inspection, mechanical and optical transfer areas, a mechanical cleaning area, an assembly and alignment area, and a transfer basement and loft for moving completed assemblies from the OAB to the LTAB. The Title I Design scope work for the LTAB includes the building plus utilities to the lase tribution to the center of the lase bay pedestal in the LTAB. The T includes the building with utilit equipment associated with the c ponents and assembly of optics c

Introduction

The LTAB, shown in Figure 1, consists of two main parts: the Laser Building and the Target Area Building. The Laser Building consists of two laser bays providing a thermally and vibrationally stable environment to house and support the components of the laser system. In addition, it contains a central three-story core structure providing experimental support space on the ground level and mechanical equipment space on the second and third levels.

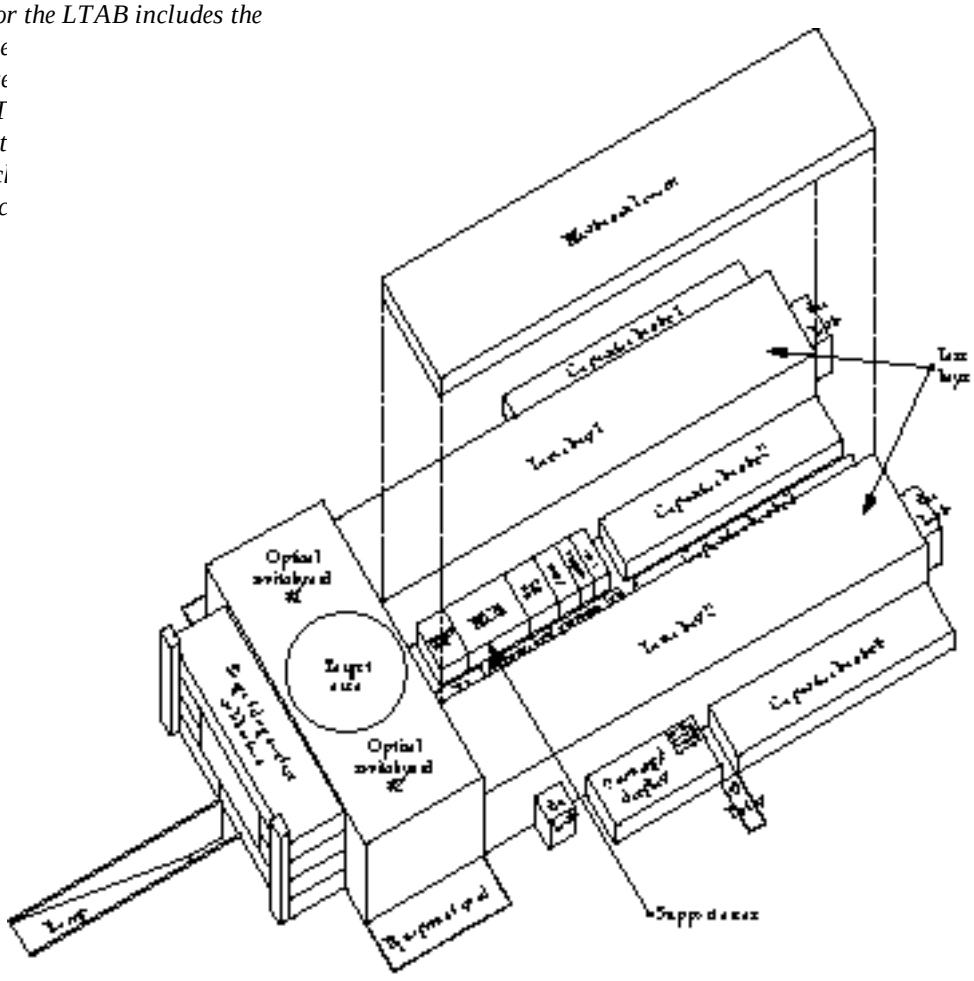

FIGURE 1. Laser and Target Area Building (LTAB). (40-00-0394-1090pb01)

The Target Area Building is divided into the target area, the switchyards, and the target diagnostic areas. The target bay and switchyards have class 100,000 clean room environments. The switchyards house and support special equipment, such as turning mirrors and chamber, final optics, and target diagnostics. The diagnostics portion houses and supports the diagnostics instruments.

The LTAB floor plan (Figure 2) is based on a U-shaped scheme with the two laser bays forming the legs of the U and the switchyards with target room at the junction. This facility scheme was selected to provide an optimum laser experimental equipment configuration and to permit the addition of a second target room in the future without major disruption to the NIF operation.

The central area between the laser bays will contain the control rooms and facility management areas. Two capacitor banks will be located in the center area between the laser bays, and one capacitor bank will be on the outside of each laser bay.

The largest research areas in the LTAB are the two laser bays at 130.1 m long by 24.4 m wide by 17 m tall, each of which covers 3158.6 m^2. The laser bay floor is a monolithic, reinforced-concrete slab 0.91 m thick resting on compacted earth.

The target building is a cylindrical structure with an inside diameter of 30.48 m and a height of 29.26 m to the base of the domed roof. The concrete wall thickness of 1.82 m is required for radiation shielding. The two switchyards, which connect the laser bays to the target room, are constructed of 1.21-m-thick reinforced-concrete walls. A 0.6-m wall thickness is required as radiation shielding for the beam and diagnostic opening in the target room walls. The switchyards are 24.4 by 30.48 m and 24.68 m high. All of these areas incorporate 1.82-m-thick monolithic slab floors for structural stability and vibration control.

The OAB (see Figure 3) is adjacent to the LTAB and will provide the necessary facilities for assembling the laser subsystem components. Each laser component will be packaged into a line replaceable

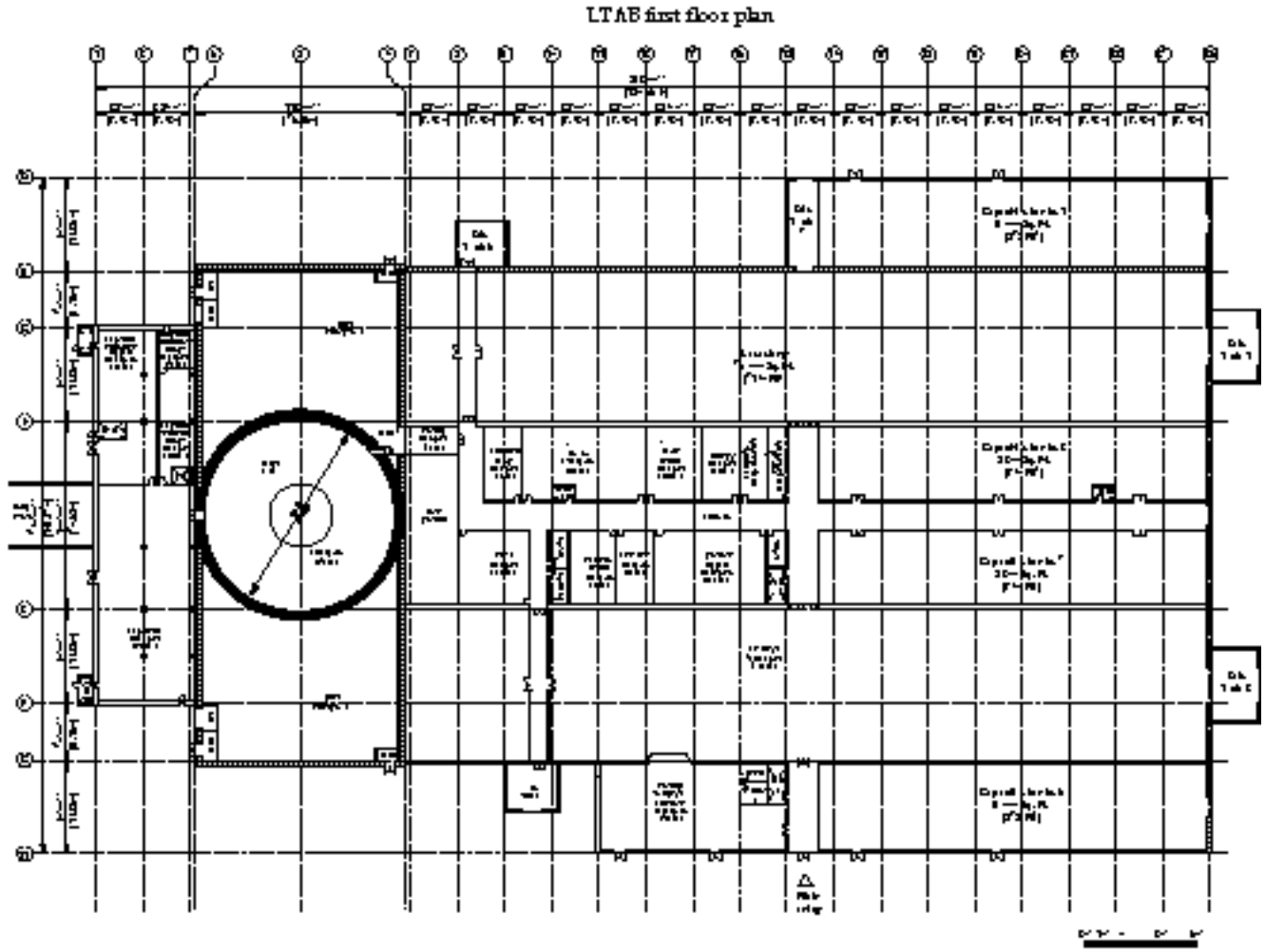

FIGURE 2. LTAB floor plan. (40-00-0394-1093)

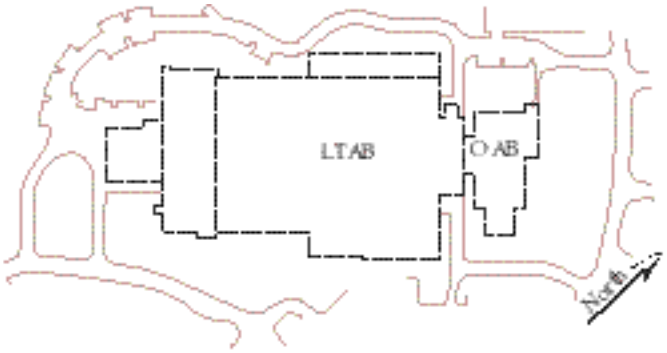

FIGURE 3. The OAB in relation to the LTAB. (40-00-1097-2229pb01)

unit (LRU) for assembling, transporting, installing, and removing the component in an efficient, safe, and cost-effective manner. Assembling the LRUs will occur in the OAB.

All components arrive at the loading dock and undergo receiving inspection in an enclosed area. Adjacent to this loading/unloading space, mechanical and optical transfer clean rooms are provided in the main part of the building for joining and transfer of optical and mechanical components of LRUs. The transfer areas contain component handling mechanisms, cleaning stations, and a staging area. The mechanical components undergo additional cleaning and partial assembly in the mechanical cleaning clean room. Final assembly, alignment, and testing of the assemblies are performed in the assembly and alignment clean room. A transfer basement and loft are provided for moving completed assemblies out of the OAB assembly area and onto a transporter for delivery through the corridor link to the LTAB.

LTAB Title I Design Functional Scope

The Title I Design functional scope for the LTAB includes all the building components; the utilities to the laser bay, switchyard, and target bay; power distribution to the center of the laser bay slab; and the target bay pedestal, which holds up the target chamber.

An important part of the Title I Design is defining the interfaces between facilities and special equipment to assure that requirements are met. We are also analyzing the performance of proposed designs and closely coordinating design development with the special equipment designers.

In developing the LTAB Title I Design, we are, through various studies, choosing among alternatives for reasonable compromises between performance and cost. The decisions made are in support of the *Preliminary Safety Analysis Report*, and we are establishing quality levels by system and/or component.

The final Title I Design deliverables include the following:

- Drawings.
- Specifications.
- Basis of design document.
- Code analysis report.
- Calculations.
- Title I construction cost estimate.
- Energy conservation report.
- Environment, safety, and health report.
- Safeguard and security report.
- Preliminary qualification and testing acceptance plan.
- Heating, ventilating, and air conditioning (HVAC) commissioning plan.
- Reliability, availability, and maintainability (RAM) analysis report.
- Fire protection design analysis.
- Major equipment list.
- Computational fluid dynamics analysis report.
- Quality level assignment report.

The drawings and specifications being prepared for the Title I Design must include general arrangements that assure physical integration and accommodation of

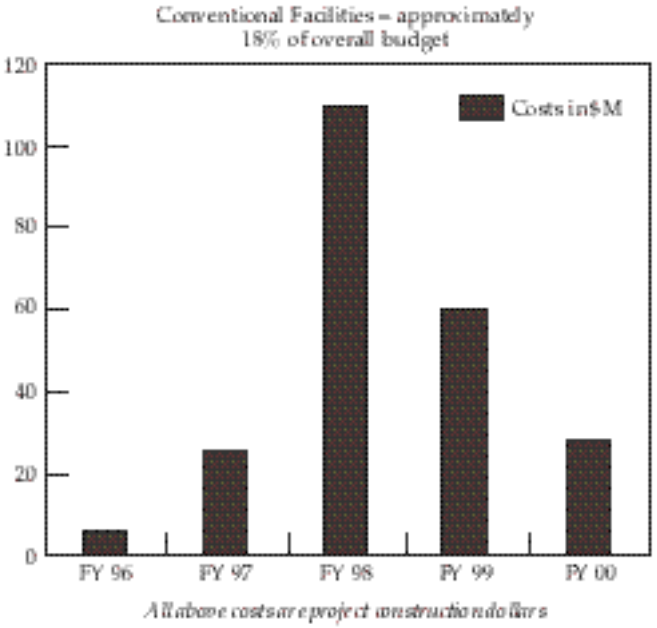

FIGURE 4. Conventional Facilities cost estimates. (40-00-1097-2230pb01)

operational requirements. They must also show analyses that confirm that requirements can be met in Title II; develop accurate construction cost estimates (Figure 4) and procurement schedules; identify potential needs for long-lead procurements; and form a firm basis for Title II design, construction planning, construction subcontract packaging, and project scheduling.

Foundation, Vibration and Thermal Stability, and Shielding Design

Several high-impact design requirements are being integrated into the Title I Design, including vibration isolation and structural stability; tight spatial temperature control in large-volume critical spaces with complex geometry; neutron shielding sufficient to protect the workers and the public, and to allow for required operation and maintenance activities; and structural position stability in severe weather extremes.

Reinforced-concrete seismic analyses were performed for the laser bay foundation and the target bay and switchyard. Our conclusion from these analyses was that the target area circular floor openings are critical to the final design. In addition, we concluded that torsional support for the target sphere should be developed, laser beam tubes and special equipment should be added, and conflicts between radial beams and the HVAC system must be resolved.

Vibration criteria are critical to the Title I Design. We have several ambient vibration analyses in progress, including the laser bay foundations and pedestals, the target bay and switchyards foundations, the master oscillator room (MOR) foundation, and the preamplifier module maintenance area (PAMMA) foundation. Several vibration analyses have been completed or are in progress. Of the unbalanced fan vibration sources analyses, the steel laser bay structure analysis is complete, while the transmission of footing vibrations to critical structures analysis is in progress. The acoustic-sound pressure-level-sources preliminary analysis of the laser bay foundation has been completed. The flow-induced-vibration-sources analysis of nitrogen cooling lines is in progress.

The allowable air temperature variation according to the Subsystem Design Requirements is 20°C, ±0.28°C. Thermal analyses to meet these criteria are in progress for the laser bay foundation slabs and the target bay structure.

The Title I shielding analysis was performed by LLNL's NIF Project team and reviewed and coordinated with Parsons Infrastructure and Technology Group, Inc., of Pasadena. We concluded from this analysis that a minimum 2-in. cover for all reinforcing should be required. The concrete of the target bay walls must be 1.82 m thick. The switchyard walls will range from 0.83 m to 1.13 m (Figure 5). The target bay concrete roof must be 1.35 m thick, and the switchyard concrete roof should be 2 ft thick.

Recent analysis (to be verified in Title II) has resulted in the following recommendations:

1. HVAC ducts can be of steel, aluminum, or fiberglass.
2. Shield door frames can be of aluminum or stainless steel.
3. Minimum rebar cover must be 2 in.
4. Boration requirements in the target bay floor are unnecessary.

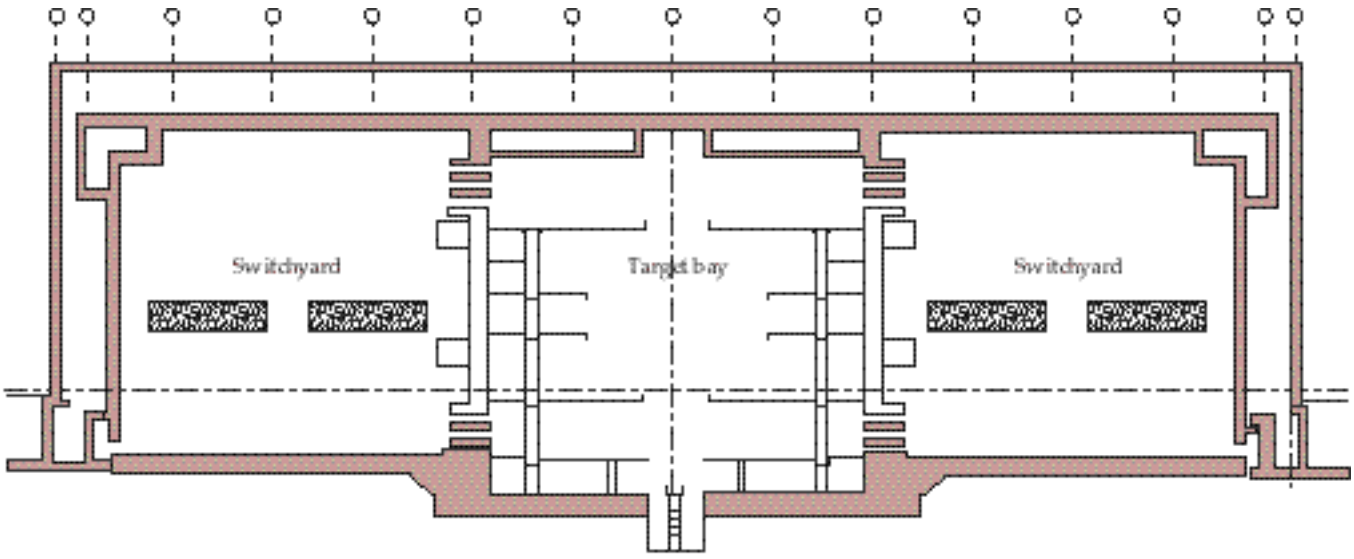

FIGURE 5. Shielding design. (40-00-1097-2231pb01)

Title II Activities

The target bay floors, pedestal, and lift pit will be designed during Title II. The laser bay interface loads and loading conditions will be provided, and the laser bay support system will be designed during Title II.

In Title II, the construction contract language, general conditions, market survey, contractor prequalification, drawing reviews, and independent cost estimate will be developed.

Title II shielding design activities include investigating whether borated concrete is required and, if so, determining the extent and degree of boration. In addition, we will be investigating whether collimation is required for the laser bay/switchyard beam penetrations.

OAB Title I Design Functional Scope

The Title I Design functional scope for the OAB includes all the building components with utilities, external access, interior spaces, and operational support equipment associated with the cleaning of mechanical components, and assembly of optics components for the LTAB (see Figure 6).

As with the LTAB, we will define the interfaces between OAB facilities and special equipment to assure that requirements are met, analyze the performance of proposed designs, and closely coordinate the Conventional Facilities design development with user groups in anticipation of the final Interface Control Documents.

The OAB Title I Design definition includes a design development phase for a clean room building to a preliminary level (± 35% design). It also confirms and formalizes user requirements and interfaces; requires drawings, specifications, and other information that assure physical integration of operational requirements; establishes quality levels by system and/or component; performs engineering and other analyses that confirm that requirements can be met in Title II Design; and confirms the budget cost model and considers alternatives for reasonable compromise between performance and cost.

The final Title I OAB Design deliverables include:

- Drawings.
- Outline specifications.
- Cost estimate.
- Engineering calculations.
- Quality Assurance Program Plan.
- Code Analysis Report.
- Fire Protection Design Analysis Report.
- Energy Conservation Report.
- Preliminary Qualification and Testing Acceptance Plan.
- HVAC commissioning plan.
- RAM analysis report.
- "Q" Level Assignments.
- Rendering.
- Materials Sample Board.

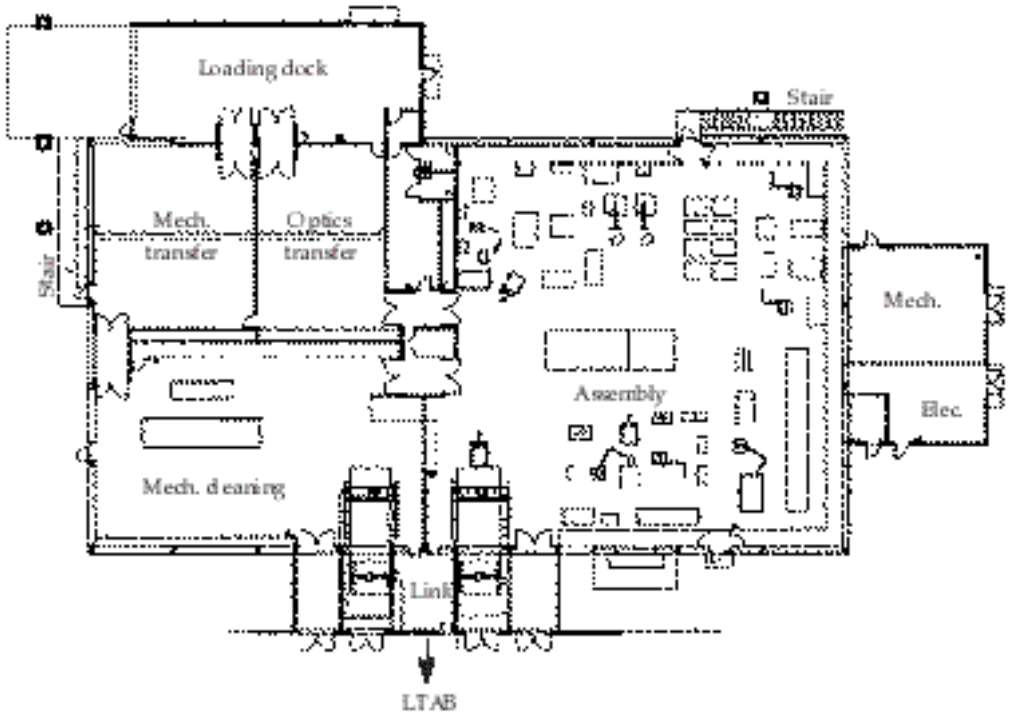

FIGURE 6. OAB floor plan with user equipment at start-up. (40-00-1097-2232pb01)

The OAB Title I Design integrates a number of high-impact design requirements, including the maintenance of 24-hour operation for Class 100 and Class 1000 clean rooms, temperature and humidity control, vibration isolation and structural stability, and facilitation of optics assembly transfers to and from the LTAB.

HVAC Systems

The reliability and availability of the HVAC system are critical to the success of the OAB to assure an uninterrupted support of LTAB experiments. Preliminary RAM analysis was performed for the HVAC system serving the Assembly / Alignment, Mechanical Cleaning, and Mechanical / Optics Transfer areas; the availability result was 99.87%.

With outdoor conditions ranging from 37°C in the summer to –5°C in the winter, the indoor conditions for a Class 100 or 1000 clean room must be 20°C ±0.5°C with 45% ±15% RH, and a Class 10,000 clean room must be 22°C ±0.5°C with 45% ±15% RH.

The Assembly / Alignment area is a Class 100 clean room, the Mechanical Cleaning area a Class 1000 clean room, and the Mechanical / Optics Transfer area a Class 10,000 clean room, each with gowning rooms and air locks. Each clean room will have a high-efficiency particulate air (HEPA) filtration system, air circulation, and pressure control.

The Class 100 clean room will have 26 recirculating fans (RFs), raised floor and return air chase, 80% HEPA coverage at the ceiling, pressurization, and vibration and noise control of the RFs. The Class 1000 clean room will have a raised floor and return air chase, 30%+ HEPA coverage at the ceiling, four RFs grouped together, pressurization, and vibration and noise control. The Class 10,000 clean room will have sidewall return, two RFs grouped together for backup, pressurization, 15%+ HEPA coverage at the ceiling, and vibration and noise control.

Title II Activities

In Title II Design, we will design, prototype, and test the assembly station for the common LRU assembly. This includes an optics insertion mechanism, rotating assembly table, and an OAB LRU transporter. Interface Control Documents will be completed and updated as needed. Procurement specifications for vertical lifts and jib cranes will be completed. The design and a prototype will be completed for the bottom-loading and top-loading LRU systems. During Title II, the LRU certification equipment will be identified, and the procurement specification will be completed.

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